مذكرة رقم : 075X24 — 19 فبراير 2024

إلى السيدات والسادة

مديرة ومديري الأكاديميات الجهوية للتربية والتكوين

المديرات والمديرين الإقليميين

المفتشات والمفتشين التربويين للتعليم الثانوي

مديرات ومديري الثانويات التأهيلية

أستاذات وأساتذة التعليم الثانوي التأهيلي

الموضوع : **الإطار المرجعي المكيف لاختبارات الامتحان الوطني الموحد للبكالوريا - 2024**

- مادة الفيزياء والكيمياء: شعبة العلوم الرياضية خيار أنجليزية -

المرجع :
- قرار وزير التربية الوطنية والتعليم العالي وتكوين الأطر والبحث العلمي رقم 2385.06 بتاريخ 23 رمضان 1427 (16 أكتوبر 2006) في شأن تنظيم امتحانات نيل شهادة البكالوريا كما تم تغييره وتتميمه؛
- المذكرة الوزارية رقم 001X24 بتاريخ 02 يناير 2024 في شأن تكييف تنظيم السنة الدراسية 2023/2024
- المذكرة الوزارية رقم 086X24 بتاريخ 25 يناير 2024 في شأن الوثيقة المرجعية الخاصة بتكييف البرامج الدراسية

سلام تام بوجود مولانا الإمام،

وبعد، فإلحاقا بالمراجع المشار إليها أعلاه، مواصلة للجهود الرامية إلى الرفع من جودة التعلمات المدرسية، وانسجاما مع التوجهات الهادفة إلى تحسين الممارسة التقويمية والرفع من مصداقيتها، عملت الوزارة على إعداد الإطار المرجعي **المكيف** للامتحان الوطني الموحد للبكالوريا الخاص بمادة **الفيزياء والكيمياء شعبة العلوم الرياضية خيار أنجليزية** لاعتماده في بناء مواضيع اختبارات المادة المذكورة بالامتحان.

وقد تم إعداد هذا الإطار المرجعي والمصادقة عليه من طرف لجن وطنية تخصصية بتمثيلية الأكاديميات الجهوية للتربية والتكوين.

مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات
- المركز الوطني للتقويم والامتحانات
البريد الالكتروني: cne@men.gov.ma ☎ : 0537714453/52 📠 : 0537714437/08/09

1. الأهداف

وتتحدد الأهداف من اعتماد الأطر المرجعية في:

1.1. التحديد الأدق لما يجب أن يستهدفه الامتحان الوطني الموحد للبكالوريا من كفايات ومهارات ومضامين وذلك بهدف التوجيه الأنجع لتدخلات مختلف الفئات المعنية بإعداد المترشحين والمترشحات لاجتياز هذا الامتحان؛

2.1. الرفع من درجة صلاحية مواضيع الامتحانات الإشهادية بجعلها أكثر تغطية وتمثيلية للمنهاج الدراسي الرسمي؛

3.1. تدقيق الأساس التعاقدي للامتحان بالنسبة لجميع الأطراف المعنية من مدرسات ومدرسين وتلميذات وتلاميذ ولجن إعداد المواضيع؛

4.1. اعتماد معيار وطني موحد لتقويم مواضيع الامتحانات الإشهادية؛

5.1. توفير موجهات لبناء فروض المراقبة المستمرة واستثمار نتائجها في وضع الآليات الممكنة من ضمان تحكم المتعلمات والمتعلمين في الموارد والكفايات الأساسية للمناهج الدراسية.

2. بنية الإطار المرجعي

يستند وضع الأطر المرجعية لمواضيع الامتحانات الإشهادية على التحديد الدقيق والإجرائي لمعالم التحصيل النموذجي للمتعلمين وللمتعلمات عند نهاية السلك التعليمي وذلك من خلال:

2.1. ضبط الموارد الدراسية المقررة في السنة النهائية لسلك البكالوريا مع حصر درجة الأهمية النسبية لكل مجال من مجالاتها داخل المنهاج الرسمي لكل مادة دراسية؛

2.2. تعريف الكفايات والمهارات والقدرات المسطرة لهذا المستوى التعليمي تعريفا إجرائيا، مع تحديد درجة الأهمية بالنسبة لكل مستوى مهاري داخل المنهاج الرسمي للمادة الدراسية المعنية؛

3.2. تحديد شروط الإنجاز.

3. توظيف الإطار المرجعي

توظف الأطر المرجعية في بناء مواضيع الاختبارات المتعلقة بمختلف المواد المعنية بالامتحان وذلك بالاستناد إلى المعايير التالية:

1.3. **التغطية** : أن يغطي موضوع الامتحان كل المجالات المحددة في الإطار المرجعي الخاص بكل مادة دراسية.

2.3. **التمثيلية** : أن تعتمد درجة الأهمية المحددة في الإطار المرجعي لكل مجال من مجالات الموارد الدراسية ولكل كفاية أو مستوى مهاري في بناء موضوع الاختبار وذلك لضمان تمثيلية هذا الأخير للمنهاج الرسمي المقرر.

3.3. **المطابقة** : أن يتم التحقق من مطابقة الوضعيات الاختبارية للمحددات الواردة في الإطار المرجعي على ثلاث مستويات:

مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات
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- الكفايات والمهارات؛
- الموارد الدراسية ومجالاتها؛
- شروط الإنجاز.

هذا، وحتى يحقق هذا الإجراء الأهداف المتوخاة منه، باعتباره خطوة أساسية للرفع من صلاحية وموثوقية الامتحانات الإشهادية، يشرفني أن أطلب منكم الحرص على تنفيذ ما يلي:

- ✓ استنساخ هذه المذكرة وتوزيعها على المعنيين بالموضوع من مفتشات ومفتشين تربويين وأستاذات وأساتذة مع العمل على إطلاع مختلف المترشحين والمترشحات لامتحانات البكالوريا على فحواها؛
- ✓ تمكين السيدات والسادة المفتشات والمفتشين التربويين للمواد المعنية بالامتحان من عقد اجتماعات ولقاءات تربوية لإطلاع المتدخلين المعنيين على مضامين هذا الإطر المرجعي؛
- ✓ دعوة السيدات والسادة المفتشات والمفتشين التربويين إلى تنظيم لقاءات تربوية مع السيدات والسادة الأستاذات والأساتذة لاعتماد هذه الأداة في التخطيط للتدريس وتوظيفها في إعداد فروض المراقبة المستمرة.

واعتبارا للأهمية البالغة التي يكتسيها هذا الموضوع، فإني أهيب بالجميع، كل من موقعه، إيلاءه كل الاهتمام والعناية اللازمتين.

و السلام.

وزير التربية الوطنية والتعليم الأولي والرياضة

شكيب بنموسى

مديرية التقويم وتنظيم الحياة المدرسية والتكوينات المشتركة بين الأكاديميات
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المملكة المغربية
وزارة التربية الوطنية والتعليم الأولي والرياضة
ⵜⴰⴳⵍⴷⵉⵜ ⵏ ⵍⵎⵖⵔⵉⴱ
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ⴷ ⵓⵙⵙⵏⵎⵔ ⴰⵎⴰⵡⴰⵙ ⴷ ⵜⵓⵙⵙⵔⵜ

الأطر المرجعية المكيفة الخاصة بالامتحان الوطني الموحد لنيل شهادة البكالوريا - 2024 -

الإطار المرجعي لمادة الفيزياء والكيمياء

شعبة العلوم الرياضية / المسلكان - أ - و - ب -

(المسلك الدولي للبكالوريا المغربية - خيار أنجليزية)

المركز الوطني للتقويم والامتحانات

2024

Cadre de référence adapté de l'examen national unifié du baccalauréat – 2024 –

Discipline : Physique Chimie

Série : Sciences Mathématiques
Filière : A et B

Sections Internationales du Baccalauréat Marocain
Option : Anglais

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Ministère de l'Education Nationale du Préscolaire et des Sports
Centre National de l'Evaluation des Examens

I- Introduction

The Ministry of National Education Preschool and Sports has prepared a reference framework related to the subject of Physics and Chemistry, a methodology tool aiming to ameliorate, specify and adapt assessment tools to the requirements of the official guidelines of Physics and Chemistry.

II- Objectives

The objectives of this reference framework are the following:

- synchronising the vision of different national Baccalaureate exam commissions concerning the acquired knowledge and skills regardless of different school textbooks of Physics and Chemistry in use.
- providing equal opportunities by improving the degree of final exam validity through a comprehensive syllabus and thorough programme coverage.
- adopting the same framework by all stakeholders so that exams' preparation could be achieved jointly and in the spirit of a contract involving teachers, learners and review panels.
- offering a resource tool that could serve as evaluation of final exams.
- providing guidelines for the preparation of continuous assessment and therefore exploiting the results in order to subsequently enable learners to master school curricula content and basic skills inherent in these programmes.

III- The layout of framework:

This framework is based on a precise and operational definition of learners' educational background knowledge in Physics and Chemistry at the end of secondary school. This would be achieved through:

- ✓ determining the contents of Physics and Chemistry programmes and their corresponding importance in terms of weighting and grading.
- ✓ giving an operational definition of skills and competencies set by specifying the degree of importance of each level of competence.
- ✓ determining the conditions of programme completion.

IV- The purpose of the framework:

This Reference Framework serves as a basic document for designing Physics and Chemistry Baccalaureate tests taking into account the following criteria:

- ✓ **Programme Coverage**

  The final exam paper should cover all programme contents of the subject defined in the framework.

- ✓ **Representativeness**

  The construction of the examination paper should consider the weight of each area and the weight of each skill level as defined in the Frame of Reference for a better representation of current syllabi.

- ✓ **Alignment with the Standards :**

  Ensure that the evaluation situations are in conformity with:
  - Skills and abilities;
  - Content;
  - Conditions of implementation.

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V- Contents

This framework is considered as a comprehensive contractual document; it consists of the following:

1. Types of assessment and exam layout;
2. Table of contents:
   - List of target resources (knowledge and skills) to be assessed;
   - Content areas and weighting;
3. Table of skill levels, their components and their weighting;
4. Specification table

1. Types of assessment and exam layout:

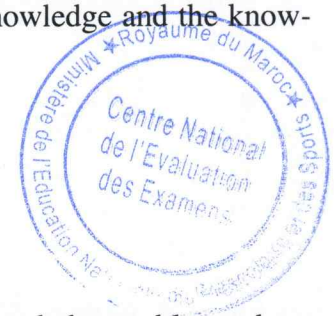
Summative assessment in the second year Baccalaureate cycle aims to cover a set of elements and check the candidate's level of mastery of these elements through familiar or new learning situations associated with the basic learning acquired in the classroom. These situations have to be tested through centred around one theme. These exercises, which may increase in difficulty in a gradual way, can start with an assessment situation and can be subdivided into independent parts.

The theme-based exercises should be related to the basic learning acquired in the classroom during courses and laboratory work, and should also be based on familiar situations and syntheses. They allow using both knowledge and skills related to the compounds of the school programme and the adoption of the scientific approach as suggested by skill levels. All this is well defined in this reference framework.

While dealing with the testing situations targeted by this summative assessment, the knowledge and the know-how to be tested should be exploited through scientific applications closely related to the real world and to the different parts of the programme with the possibility of expanding the assessment of the knowledge and skills to include physical or chemical quantities related to the fundamental quantities mentioned in the Framework.

1.1. Types of Assessment:

The exam paper may present evaluation situations designed to assess the knowledge and the know-how using test items such as:



- MCQ (multiple choice questions);
- T/F (True/False);
- Matching…;
- Short-answer questions;
- Essay questions;
- Synthesis questions, Complex issues (whose solutions require the use of knowledge and know-how related to one or more areas).

1.2. The layout of the national Bac exam:

✓ **The exam paper Components :**

- The Physics and Chemistry national Bac exam test paper covers the whole school year programme and takes place at the end of the secondary school education.
- The Physics and Chemistry national exam test paper, Mathematical Sciences section: A and B – consists of 4 or 5 thematic exercises.

✓ **Completion time:** four (4) hours.
✓ **The candidate is authorized to use:** a non-programmable scientific calculator, writing and drawing pens and pencils.
✓ **Correction Grid**: It should include the number of the test items and the mark assigned to them; the questions' numbers; the key and marking scale the mark; a column mentioning the question reference according to the Framework.

2. Table of Contents:

The table of contents presents the content areas targeted by the assessment and the list of essential objectives (knowledge and skills) related to each content area. This knowledge and skills constitute the minimum threshold to assess in candidates.

This table also highlights the importance the weighting for each content area, based on the time allotted to its completion and the importance of the content in the syllabus.

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List of the required knowledge and skills

First Principal Part: Physics

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The First Topic: Waves

1-Progressive Mechanical Waves

- Define a mechanical wave and its wave speed.
- Define a transverse wave and a longitudinal wave.
- Define a progressive wave.
- Know the relationship between displacement of a point from the propagation medium and the source displacement: $y_M(t) = y_S(t-\tau)$.
- Exploit the relationship between time delay, distance and wave speed.
- Exploit experimental documents and data in order to determine:
  * distance;
  * time delay;
  * wave speed.
- Suggest a scheme of experimental set-up (mounting) to measure time delay or to determine the wave speed during the wave propagation.

2- Periodic Progressive mechanical waves

- Recognise a periodic progressive wave and its period.
- Define sinusoidal progressive wave, period, frequency and wavelength.
- Know (Recall) and use the relationship $\lambda = v.T$
- Know the condition to have the diffraction phenomenon: aperture/slit length is less or equal wavelength.
- Know (Recall) the characteristics of the diffracted wave.
-Define a dispersive medium.
- Exploit the experimental documents to Recognise the diffraction phenomenon and highlight the characteristics of the diffracted wave.
- Suggest a scheme of an experimental set-up to highlight the phenomenon of the diffraction in the case audible and ultrasonic mechanical wave.

3- Propagation of a light wave

- Know that light has a wave aspect, based on the diffraction phenomenon.
- Know the influence of the size of the slit (opening) or of the obstacle on the diffraction phenomenon.
- Exploit a document or a diffraction pattern in the case of light waves.
- Know (Recall) and exploit the relationship: $\lambda = \frac{c}{v}$.
- Define a monochromatic and a polychromatic light.
- Know the boundaries of wavelengths and their colours for the visible spectrum in the vacuum.
- Know the frequency of a monochromatic radiation does not change as it passes from one transparent medium to another.
- Know that the transparent media are more or less dispersive.

- Know (Recall) and exploit the relationship: $n = \frac{c}{v}$
- Determine (find out) the refractive index of transparent medium for a given frequency.
- Suggest the scheme of an experimental set-up allowing us to highlight the diffraction phenomenon in the case of light waves.
-Know (Recall) and exploit the relationship $\theta = \lambda/a$; and know the units and the meaning of θ and λ.
- Exploit experimental measurements to verify the relationship $\theta = \lambda/a$.

The Second Topic: Nuclear Transformations

1-Radioactive Decay

- Know the meaning (significance) of the symbol ${}^{A}_{Z}X$ and give the corresponding composition of the nucleus.
- Recognise the isotopes of a chemical element.
- Recognise the areas of stability and instability of the nuclei on the N-Z diagram.
- Exploit the N-Z diagram
- Define a radioactive nucleus.
- Know and exploit the two laws of conservation.
- Define the radioactivity: α , β^+ & β^- and the $\gamma - radiation$.
- Write the equation of a nuclear reaction by applying the two conservation laws.
- Recognise the type of radioactivity using the equation of a nuclear reaction.
- Know and exploit the law of the radioactive decay, and exploit its curve.
- Know that 1Bq is equal to one decay per second.
- Define the time constant τ and the half-life $t_{1/2}$.
- Exploit the relationships between τ , $t_{1/2}$ and λ (decay constant).
- Use the dimensional analysis to determine the units of λ and τ .
- Determine the suitable radioactive element in order to date a given event.

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2- Nucleus, Mass and Energy

- Define and calculate the mass defect and the binding energy.
- Define and calculate the binding energy per nucleon and exploit it.
- Use different units of mass, energy and the relationships between their units.
- Exploit the binding energy per nucleon curve (Aston curve) to identify the most stable nucleus.
-Know the relationship of the mass-energy equivalence; and calculate the energy of mass.
- Establish the energy balance ΔE of a radioactive decay (α , β^+ , β^-) using: mass energies and/or the energy diagram.
- Calculate the energy released (produced) by a radioactive decay (α , β^+ , β^-) : $E_{pro} = |\Delta E|$.

The Third Topic: Electricity

1- RC Dipole (RC Circuit)

- Represent the voltages (Electric Potential Difference) u_R and u_C using the receiver convention; and show the polarity of capacitor plates.

- Know and exploit the relationship $i = \frac{dq}{dt}$ for a capacitor in receiver convention.
- Know and exploit the relationship q = C.u.
- Know the capacitance of a capacitor, its unit F and their submultiples $\mu F, nF \text{ and } pF$.
- Determine the capacitance of a capacitor graphically or by calculation.
- Know the capacitance of the equivalent capacitor in series or in parallel assemblies; and recall the interest of each one.
- Find out the differential equation and verify its solution when the RC dipole is submitted to a step voltage.
- Determine the voltage expression $u_C(t)$ between capacitor terminals when the RC dipole is submitted to a step voltage, and deduce both the expression of the intensity current in the circuit and the capacitor charge.
- Recognise and represent the variation curves of $u_C(t)$ between the capacitor terminals and different physical quantities associated to it, and exploit them.
- Recognise that the voltage between capacitor terminals is a continuous function of time at t=0, and the current intensity is a discontinuous function at t=0.
- Know and exploit the time-constant expression.
- Use the dimensional analysis (dimensional equations).
- Exploit experimental documents in order to:
  * recognise the observed voltages.
  * highlight the influence of R and C on the charging and the discharging processes.
  *determine the time-constant and charge duration.
  *determine the state's type (transient or steady) and the time interval for each one.
- Suggest the scheme of the experimental assembly that allows studying the response of the RC dipole submitted to a step voltage.
- Know how to connect an oscilloscope and a datalogger to monitor different voltages.
- Determine the influence of R and C and the amplitude of the step voltage on the RC dipole response.
- Find out the expression of the electric energy stored in a capacitor.
- Know and exploit the expression of the electric energy stored in a capacitor.

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2- RL Dipole (RL Circuit)

- Represent the voltages (Electric Potential Difference) u_R and u_L using the receiver convention.
- Know and exploit the voltage expression $u = r.i + L.\frac{di}{dt}$ between the inductor (coil) terminals using the receiver convention.
- Know the meaning of the physical quantities involved in the expression of the voltage u between the inductor's terminals and their units.
- Determine the two characteristics of the inductor (the inductance L, the resistance r) exploiting experimental results.
- Find out the differential equation and verify its solution when the RL dipole is submitted to a step voltage.
- Determine the current intensity expression $i(t)$ when the RL dipole is submitted to a step voltage, and deduce the voltage expressions between the inductor terminals and the resistor terminals.
- Recognise and represent the variation curves of current intensity $i(t)$ in terms of time across the inductor and different physical quantities associated to it, and exploit them.

- Know that the inductor delays the appearance and the disappearance of the current, and that the current intensity is a continuous function but the voltage between their terminals is a discontinuous function at t=0.
- Know and exploit the time-constant expression.
- Use the dimensional analysis (dimensional equations).
- Exploit experimental documents in order to:
  * recognise the observed voltages;
  * highlight the influence of R and L on the response of a RL dipole;
  * determine the time-constant.
- Suggest the scheme of the experimental assembly that allows studying the response of the RL dipole which is submitted to a step voltage.
- Know how to connect an oscilloscope and a datalogger to monitor different voltages.
- Determine the influence of R and L and the amplitude of the step voltage on the RL dipole's response.
- find out the expression of the electro-magnetic energy stored in an inductor.
- Know and exploit the expression of the magnetic energy stored in a inductor.

3-RLC Series Circuit

- Define and Recognise the undamped (periodic), the underdamped (pseudo-periodic) and the overdamped (non-periodic) states.
- Recognise and represent the variation curves of the voltage between capacitor terminals in terms of time for the three states mentioned above; and exploit them.
- Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the negligible damping case and verify its solution.
- Know and exploit the expression of the charge $q(t)$ and deduce the current intensity expression $i(t)$ flowing in the circuit and exploit it.
- Know and exploit the natural period expression.
- Explain energetically the three regimes.
- Know and exploit the energetic diagrams.
- Know and exploit the expression of the total energy in the circuit.
- Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the damping case.
- Know the role of the oscillation maintenance device which compensates the energy dissipated by Joule effect in the circuit.
- Find out the differential equation for the voltage between the capacitor terminals or for its charge $q(t)$ in the RLC circuit that is maintained by using a generator delivering a voltage which is proportional to the current intensity: $u_G(t) = k.i(t)$
- Exploit experimental documents in order to:
  * recognise the observed voltages;
  * recognise the damping states;
  * highlight the influence of R, L and C on the oscillation phenomenon;
  * determine the values of the period and the natural period.
- Suggest the scheme of the experimental assembly that allows the study of the free oscillations in the RLC series circuit.
- Know how to connect an oscilloscope and a datalogger to monitor different voltages.

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- Distinguish between free and forced oscillations.
- Know the role of the driver and the resonating system.
- Know and exploit the expression $|\varphi| = \frac{2.\pi.\tau}{T}$ of the phase of physical quantity relative to another.
- Know and exploit the impedance expression $Z = \frac{U}{I}$ of a circuit.
- Know the unit of the impedance (Ω)
- Recognise the electric resonance phenomenon and its characteristics.
- Know and exploit the quality factor expression $Q = \frac{N_\circ}{\Delta N}$
- Exploit experimental documents in order to:
  * know the influence of the resistance on the quality factor.
  * determine the width of the passband.
- Recognise the phenomenon of the overvoltage.
- Know the instantaneous power in the alternating sinusoidal state.
- Find out and exploit the average power expression $P = U.I.\cos\varphi$
- Know the power factor.

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The Fourth Topic: Mechanics

1-Newton's Laws

- Know and exploit expressions of the instantaneous velocity vector and the acceleration vector.
- Know the unit of acceleration.
- Know the components of the acceleration vector in Cartesian coordinate system and in Frenet frame.
- Exploit the dot product $a.v$ to determine the nature of motion (accelerated or decelerated).
- Know the Galilean frame of reference.
- Know Newton's second law $\Sigma F_{ext} = m.\frac{\Delta V_G}{\Delta t}$ and $\Sigma F_{ext} = m.\, a_G$ and its range of validity.
- Recognise the role of mass in the inertia of a system
- Apply Newton's second law to determine the kinetic quantities v_G and a_G and dynamic quantities and exploit them.
- Know and use Newton's third Law.
- Use of the dimensional analysis (dimensional equations).

2-Applications

- Know and exploit the two models of frictional fluids (viscous forces): $F = -k.v.i$ and $F = -k.v^2.i$
- Exploit the curve $v_G = f(t)$ to determine:
  * the terminal speed;
  * the characteristic time τ ;
  * the initial state and the steady state.
- Apply Newton's second law to find out the differential equation of a solid's centre of inertia motion in frictional vertical fall.
- Know and apply the Euler's method to solve approximately differential equation.

- Define the vertical free fall.
- Apply Newton's second law to find out the differential equation of a solid's centre of inertia motion in vertical free fall and solve it.
- Know and exploit the characteristics of the uniformly accelerated straight line motion and its parametric equations (t is the parameter).
- Exploit the velocity-time graph: $v_G = f(t)$.
- Select the appropriate frame of reference to study motion.
- Apply Newton's second law to find out the differential equation of a system's centre of inertia motion in horizontal or inclined plane and determine the characteristics of kinetic and dynamic quantities of motion.
- Exploit a document representing the path (trajectory) of a projectile in a uniform gravitational field to:

* determine the type of the motion (plane);
* represent the velocity and the acceleration vectors;
* determine the initial conditions and some parameters characterizing motion.

- Apply Newton's second law in the case of a projectile in a uniform gravitational field to:

* find out differential equation of motion;
* deduce the parametric equations of motion and exploit them;
* establish the equation of the path (trajectory), find out the expressions of the range and the maximum height of the path and exploit them;

3- Quantitative Relationship between the Sum of Moments $\sum M_{\Delta}$ and the Angular Acceleration $\ddot{\theta}$

- Locate a point from a solid in rotational motion around a fixed axis by its angular displacement.
- Know the angular acceleration expression and its unit.
- Know and exploit the expressions of the two components a_N and a_T in terms of angular quantities.
- Know and apply the fundamental relationship of dynamics in the case of rotation around a fixed axis in order to establish the differential equation of the motion, and solve it.
- Know the unit of the moment of inertia.
- Know and exploit the characteristics of a uniformly varied rotational motion and its parametric equations (t is the parameter).
- Apply Newton's second law and the fundamental relationship of dynamics on a mechanical system consisting of two solids, one in straight translational motion and the other in rotational motion, to establish the differential equation and to determine kinetic and dynamic quantities.

4-Oscillating Systems

- Know the oscillatory motion.
- Recognise the free oscillations
- Recognise the damping of oscillations, their different types and their states.
- Know that in the case of a weak damping (underdamped state) , the period is close to the natural period.
- Know the characteristics of the restoring force exerted by a spring on a solid in motion.
- Exploit the curves: $x_G(t)$, $v_G(t)$ and $a_G(t)$.
- Apply Newton's second law to the oscillating system (solid-spring) to establish the differential equation of motion and verify its solution when the oscillating system vibrates in the following situations: horizontal, inclined or vertical.

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- Determine the type of motion of the oscillating system (solid-spring); write the equations: $x_G(t)$, $v_G(t)=\frac{dx}{dt}$ and $x_G(t)$ and exploit them.
- Know the meaning of the physical quantities involved in the expression of the parametric equation $x_G(t)$ of the oscillating system (solid-spring) and determine them using the initial conditions.
- Establish the expression of the natural period of the oscillating system (solid-spring).
- Know and exploit both the expression of the natural period and that of the natural frequency of the oscillating system (solid-spring).
- Determine the two types of damping (solid and fluid) through the shape of the displacement-time graph $x_G(t)$.
- Apply the fundamental relationship of dynamics, in the case of rotation, on a physical pendulum to establish the differential equation of the motion with the small oscillation amplitude in the negligible friction case.
- Determine the nature of the motion for a physical pendulum in the small oscillation amplitude case; then, write and exploit the equations of the motion $\theta(t)$, $\dot{\theta}(t)$ and $\ddot{\theta}(t)$.
- Know the meaning of the physical quantities involved in the expression of the time-equation $\theta(t)$ for the physical pendulum and determine them using the initial conditions.
- Establish the expression of the natural period for the physical pendulum.
- Know and exploit the expression of the natural period and the natural frequency for the physical pendulum in the small oscillation amplitude case.
- Exploit the diagrams $\theta(t)$, $\dot{\theta}(t)$ and $\ddot{\theta}(t)$ to determine the characterizing quantities of the physical pendulum motion in the small oscillation amplitude.
- Apply Newton's second law and the fundamental relationship of dynamics for a mechanical oscillating system containing an object in translational motion and another one in rotational motion in different situations, in order to establish the differential equation and to determine the kinetics and dynamics quantities.

5- Energy Aspects

- Determine the work of an external force exerted by a spring.
- Know and exploit the expression of the elastic potential energy.
- Know and exploit the relation between the work of a force applied by a spring and the elastic potential energy change.
- Know and exploit the expression of the mechanical energy of a solid-spring system.
- Exploit the conservation and the non-conservation of the mechanical energy of a solid-spring system.
- Exploit the energy diagrams.
- Exploit the expression of the gravitational potential energy and the expression of the kinetic energy to determine the mechanical energy of the physical pendulum in the small oscillations case.
- Exploit the conservation of the mechanical energy of a physical pendulum in the small oscillations case.

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The First Topic : Fast and Slow Transformations of a Chemical System

1- Fast and slow transformations

- Write the equation of the reaction associated with a redox (oxidation-reduction) transformation, and identify the two pairs involved.
- Determine from experimental results the effect of kinetic factors on the rate of reaction.

2- Temporal Monitoring of a Chemical Transformation – Rate of Reaction

- Justify the different operations carried out during the monitoring of the time-evolution of a system and exploit the experimental results.
- Determine the point of equivalence during a titration and exploit it.
- Exploit the different curves of time-evolution of the following:
  the amount of substance of a chemical specie, its concentration, the progress of a reaction, conductivity, conductance, pressure and volume.
- Draw the progress table of a reaction and exploit it.
- Know the expression of the volume rate of reaction.
- Know the effect of reactant concentration and the temperature on the volumetric rate of reaction.
- Explain qualitatively the reaction rate change using the plotted evolution's curves,.
- Determine graphically the value of the volumetric rate of reaction.
- Define the half-life $t_{1/2}$ of a chemical reaction.
- Determine the half-life $t_{1/2}$ of the chemical reaction graphically or through exploiting the experimental results.
- Interpret the effect of concentration of one of the reactants and/or temperature on the number of effective collisions per unit of time.

The Second Topic : Non-Completion Transformations of a Chemical System

1- Reversible chemical transformations

- Define an acid and a base according to Bronsted.
- Write the equation of the acid-base reaction and identify the two pairs involved.
- Determine the pH for an aqueous solution.
- Calculate the final progress of the reaction that occurs between an acid and water taking into consideration the value of both the concentration and this acid's pH aqueous solution; then, compare it with the maximum progress.
- Define the final progress rate of a reaction, and determine it using experimental data.
- Interpret the chemical equilibrium state at a microscopic level.

2- Equilibrium State of a Chemical System

- Use the relationship linking the conductance G of a solution part to the effective molar concentrations [Xi] of Xi ions in the solution.
- Know that when the state of equilibrium of the system is reached, the amount of substances will remain steady, and that this equilibrium state is dynamic.

- Give and use the expression of the reaction quotient Q_r through the reaction equation.
- Know that, the reaction quotient in equilibrium $Q_{r,eq}$, associated to the reaction equation of a chemical system, takes a value independent of concentrations, called equilibrium constant K.
- Know that, for a given transformation, the final progress rate depends on the equilibrium constant and the initial state of the chemical system.

3- Transformations associated with the acid-base reactions in aqueous solution

- Know that the ionic product of water K_e, is the equilibrium constant associated with the equation of the reaction of water autoprotolysis (self-ionization of water).
- Know the relationship $pK_e = -\log K_e$
- Determine the nature of aqueous solution (acid, basic or neutral) based on its pH value.
- Determine the pH value of aqueous solution based on the molar concentration of ions H_3O^+ or HO^-.
- Write and use the expression of the acid dissociation constant K_A associated with the reaction of an acid with water.
- Know the relationship $pK_A = -\log K_A$.
- Determine the equilibrium constant associated to the equation of acid-base reaction using the acid dissociation constants of existing pairs.
- Indicate the predominant chemical specie taking into consideration pH of aqueous solution and pK_A of pair acid/base.
- Exploit the predominance and distribution diagrams of acidic and basic chemical species existing in aqueous solution.
- Write the equation of titration reaction (use only one arrow)
- Know the experimental set-up of an acid-base titration.
- Exploit the curve or the results of the titration.
- Determine and exploit the point of equivalence.
- Justify the choice of a suitable indicator to determine the equivalence.

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The Third Topic: Evolution Direction of a Chemical System

1- Spontaneous evolution of a chemical system

- Calculate the value of the quotient of reaction Q_r of a chemical system in given state.
- Determine the direction of spontaneous evolution of a chemical system.

2- Spontaneous transformations in batteries and recovery of energy

- Draw a cell diagram / diagram of an electrochemical cell (battery)
- Determine the direction flow of the charge carriers in a cell using the criterion of spontaneous evolution.
- Interpret the functioning of a battery based on: the direction of electric current flow, the electromotive force (emf), the electrode reactions, the polarity of electrodes or the movement of charge carriers.
- Write the half-equation that occurred in each electrode (use double arrows) and write the overall equation of the reaction during the battery functioning (use one arrow).
- Establish the relationship between the amount of substance of chemical specie produced or consumed, the current intensity and the operating duration of a battery. Use this relationship to determine other quantities (quantity of charge, progress of the reaction, change of the mass...).

Contents and their weights

The following table highlights the weight of each content.

Principal Part	Topic	Weight
PHYSICS	Waves	12,5 %
	Nuclear transformations	8,5 %
	Electricity	21 %
	Mechanics	25 %
CHEMISTRY	Fast and slow transformations of a chemical system	10 %
	Non-completion transformation of a chemical system	15 %
	Evolution direction of a chemical system	8 %

3-Table Containing Skill Levels, their Components and their Weights

In addition to assessing the knowledge and skills inherent in the different parts of the programme at the end of the second year Baccalaureate, the credential assessment will focus on a set of fundamental skills in science categorised according to three levels as shown in the following table:

Skill level	Components	Weight
Using resources (Knowledge and skills)	• Know and use: symbols - conventions - units - physical quantity order - definitions - laws - principles - models - formulae - relationships… • Describe and explain a phenomenon. • Predict the evolution of a physical phenomenon or a chemical system.	45%
Applying an experimental solution	• Suggest an experimental process. • Suggest the scheme of an experimental set-up. • Distinguish different parts of an experimental set-up and determine the function of each part. • Exploit experimental data,Analyse and draw conclusions. • Predict the possible risks in experimental situation and use appropriate security measures	15 %
Solving the problem	• Mobilize necessary resources. • Organize resolution steps. • Use mathematical tools, curves and tables. • Construct a logical deduction or prove it. • Describe andAnalyse data or scientific results, and present practical conclusions. • Give an opinion or express a critical view.	40%

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4- Specification Table

The table of specification presents:

- The contents and their weights;
- The skill levels and their weights;
- Contents and skill levels expressed in percentage.

Principal Part	Topics \ Skill levels	Using resources	Applying an experimental solution	Solving the problem	TOTAL
		45%	15 %	40 %	
PHYSICS	Waves	5,6 %	10 %	5%	12,5 %
	Nuclear Transformations	3,8%		3,4 %	8,5 %
	Electricity	9,5 %		8,4 %	21 %
	Mechanics	11,2 %		10%	25 %
CHEMISTRY	Fast and Slow Transformations of a Chemical System	4,5 %	5 %	4%	10 %
	Non-completion transformation of a chemical system	6,8 %		6%	15 %
	Evolution direction of a chemical system	3,6%		3,2 %	8 %
TOTAL		45 %	15 %	40 %	100 %

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